AMERICAN MUSEUM NOVITATES

Number 849 Published by THE AMERICAN MUSEUM OF NATURAL HISTORY New York City May 18, 1936

ADDITIONS TO THE PUERCO FAUNA, LOWER PALEOCENE

BY GEORGE GAYLORD SIMPSON

The descriptions and comments here published were originally prepared as an appendix to 'Paleocene Faunas of the San Juan Basin, New Mexico,' by the late Dr. W. D. Matthew. Publication of this splendid memoir, one of the principal results of Doctor Matthew's life work, is still delayed and in the meantime it seems imperative to place the new forms here described on public record in order to facilitate general reviews of the Paleocene and more detailed work now in progress.

The specimens here described are from collections made by an American Museum party under my direction in 1929 and by University of California parties under C. L. Camp in 1928 and 1930. The latter collections were brought to the Museum in 1932 by R. A. Stirton for identification and when they were found to include two new forms and a more complete specimen of one already known he very kindly entrusted the description of these to me.

The American Museum 1929 collection includes three new species, described in this paper, and also a fine skull and skeleton of a crocodile, the first from the Paleocene (already briefly characterized),[1] a good skull and hind limb of *Plagioptychus coarctatus* (far the best known material of this genus), and numerous other specimens of known species. This material was placed in Doctor Matthew's hands in 1930 for inclusion in his memoir, and regarding the *Plagioptychus* skull he expressed the opinion that it proved the generic validity of that name (a subgenus in his original manuscript). He had, however, barely begun the study of these specimens when his fatal illness forced his sudden departure from the Museum and none of his observations on them were inserted by him in his manuscript. The *Plagioptychus* skull will be figured in his memoir. The present paper does not consider the new collection as a whole but only describes the new forms.

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[1] Simpson, G. G. 1930. '*Allognathosuchus mooki*, a new crocodile from the Puerco Formation.' Amer. Mus. Novitates, No. 445.

MULTITUBERCULATA

Ptilodontidae

KIMBETOHIA,[1] NEW GENUS

TYPE.—*Kimbetohia campi*, new species.

DISTRIBUTION.—As for the type species.

DIAGNOSIS.—A genus of very small, earliest Paleocene multituberculates. Four upper premolars. Antepenultimate premolar with three cusps, one external and two internal, wider than long. Penultimate premolar nearly as large, rounded quadrate, with four equal cusps. Last premolar with well-developed inner cusp row, second row nearly complete but with several fewer cusps, and outer, third, row incipient (one cusp in type).

This very important specimen is wholly unlike anything previously found in the Puerco. Previous multituberculates from this formation have belonged to the genera *Taeniolabis* and *Eucosmodon*. The difference of the present form from *Taeniolabis* is too obvious to require further comment. Upper teeth of *Eucosmodon* are not known from the Puerco, but the type of this genus is so much smaller than any Puerco or Torrejon species of *Eucosmodon* that generic distinction is suggested,[2] and it differs generically from Torrejon specimens of upper premolars referred to *Eucosmodon*, as in the latter the penultimate premolar is relatively larger, and tends to be more complex, and the last premolar has only one complete row of cusps and one very incomplete row. It is also probable that at least the Torrejon species referred to *Eucosmodon* had only three upper premolars, whereas this form certainly had four, as in *Ptilodus*.

This genus differs from *Ptilodus* in the three-cusped antepenultimate premolar, slightly less reduced penultimate, and shorter, broader last premolar with the second row long but with only about half as many cusps as the inner row.

So far as present knowledge of it is concerned, *Kimbetohia* would make an admirable ancestor for *Ptilodus*, size and morphology suggesting a close but more primitive relative, in keeping with its greater age.[3] It has several times been remarked[4] that the known distribution of Paleocene multituberculates was peculiar in that the Puerco forms were much more specialized than the more common later forms, *Ptilodus*,

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[1] Kimbetoh, the well-known arroyo and trading post near the type locality.

[2] Difference in size, in itself is not a generic character, but in practice contemporaneous species of very markedly different size commonly prove to belong to different genera.

[3] So far as surely identified *Ptilodus* is confined to the Torrejon, and is also doubtfully reported in the Upper Paleocene, but not at any pre-Torrejon level.

[4] E.g., in: Granger, W. and G. G. Simpson. 1929. 'A revision of the Tertiary Multituberculata.' Bull. Amer. Mus. Nat. Hist., LVI, pp. 601–676 (p. 668).

Ectypodus, etc. The discovery of this specimen goes far to remove this anomaly.

Eucosmodon gratus Jepsen, from the basal Fort Union of Northern Wyoming, is of about the same size as this species, or perhaps even smaller, but no comparable parts are known. It may belong to *Kimbetohia*, but it is very improbable that the species are the same.

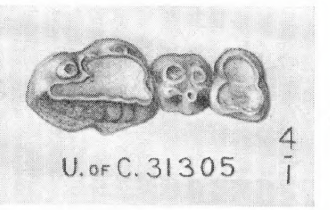

Fig. 1. *Kimbetohia campi*, new genus and species. Type, Univ. of California No. 31305, last three premolars of right upper jaw. Crown view. Four times natural size.

Kimbetohia campi,[1] new species

TYPE.—Mus. Paleo. Univ. Calif. No. 31305, skull fragment with last three premolars and part of first of the right side. Collected by Camp and Vander Hoof, 1928.

HORIZON AND LOCALITY.—Lower fossil level, Puerco Formation, Bitonitsoseh[2] Arroyo, San Juan Basin, New Mexico.

DIAGNOSIS.—Only species surely referable to the genus as defined above. Last premolar with cusp formula probably 1:4:7 (outer:middle:inner). Measurements as below:

Measurements:	Antepenultimate P	Length 1.9
		Width 2.2
	Penultimate P	Length 1.7
		Width 1.8
	Last P	Length 4.1
		Width 2.8

CREODONTA

Arctocyonidae

Oxyclaenus simplex

Mus. Paleo. Univ. Calif. No. 31270, from the upper level of the Puerco in Barrel Spring Arroyo, includes left P^4–M^3. As shown by the measure-

[1] Charles L. Camp.

[2] This is the local and, I think, preferable name for the arroyo between Kimbetoh and Escavada, called "a nameless arroyo" by Granger and Sinclair, and sometimes called Eduardo Arroyo. I have not seen the Indian (Navajo) name written, and I do not know how to spell it, but this roughly approximates the pronunciation.

ments, it differs slightly in size and proportions from the type of *Oxyclaenus simplex*, but the structure is otherwise practically identical and it probably belongs to that species. *O. simplex* is a relatively rare species, in contrast to the fairly common *O. cuspidatus*, and P^4 was not previously known. In this specimen it is similar to that of *O. cuspidatus*, but the protocone is still larger, nearly equal to the external cusp and closely applied to the latter.

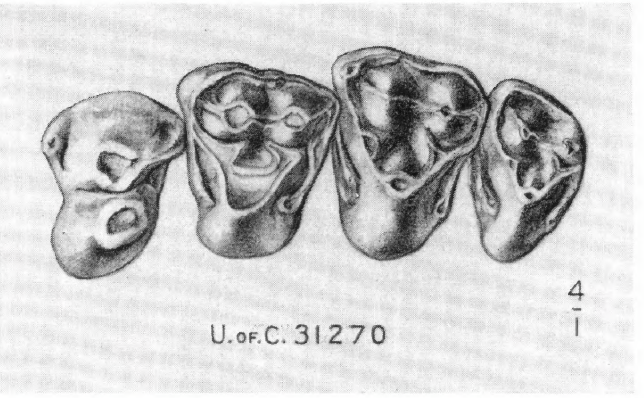

Fig. 2. *Oxyclaenus simplex*. Univ. of California No. 31270, left upper P^4–M^1. Crown view. Four times natural size.

			U. Calif. 31270	Type, Amer. Mus. 3107
Measurements:	P^4	Length	4.6	...
		Width	5.9	...
	M^1	Length	4.9	5.0
		Width	5.7	5.9
	M^2	Length	4.9	5.5
		Width	6.5	7.0
	M^3	Length	3.3	3.5
		Width	5.4	5.7

Chriacus antiquus, new species

TYPE.—Amer. Mus. No. 27714, right upper jaw with P^3 and M^{1-3}. Found by A. C. Sawtelle, American Museum Expedition, 1929.

HORIZON AND LOCALITY.—Upper level, Puerco Formation, Barrel Spring Arroyo, San Juan Basin, New Mexico.

DIAGNOSIS.—Length M^{1-3} about 19.5 mm. P^3 with distinct parastyle and small protocone. Hypocone strong on M^1 and somewhat projecting internally, present on M^2 but less internal, absent on M^3 except as a cingulum. Cingula not complete around inner faces of protocones. No distinct protostyles, but anterior cingula present. External cingula evenly developed, with weak median embayment on M^1, not on M^2. M^3 obliquely triangular, with strong parastylar projection. Enamel nearly smooth.

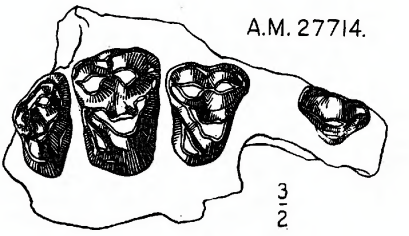

Fig. 3. *Chriacus antiquus*, new species. Type, Amer. Mus. No. 27714, right P^3 and M^{1-3}. Crown view. One and one-half natural size.

This highly distinctive form is an unexpected element in the Puerco fauna. It somewhat resembles *Oxyclaenus* and *Loxolophus*, more especially the latter in the form of the molars, but is generically distinguished from either by the hypocones. Closest comparison is with the Torrejon genus *Chriacus*, in which I have placed it in the absence of any clear generic distinctions, although the strong specific differences and the rarity of genera common to the two formations suggest that it may eventually prove to belong to a new genus.

Measurements: M^{1-3} ca. 19.5 mm.

P^3	Length	6
	Width	4
M^1	Length	7
	Width	8
M^2	Length	7.5
	Width	10
M^3	Length	5.5
	Width	8

Protogonodon grangeri,[1] new species

TYPE.—Amer. Mus. No. 27713, lower jaws, cemented together, with roots of right C–P_3, crowns of right P_4–M_3, roots of left P_{2-3}, and crowns of left P_4–M_3 (that

[1] Dr. Walter Granger.

of M_1 obscure on this side). Found by G. G. Simpson, American Museum Expedition, 1929.

HORIZON AND LOCALITY.—Upper level, Puerco Formation, Barrel Spring Arroyo, San Juan Basin, New Mexico.

DIAGNOSIS.—Length M_{1-3} 29.5 mm. Molar proportions about as in *P. pentacus*, except that M_3 is small, long and narrow, hypoconulid projecting and tending to form a third lobe. P_4 low, protoconid little if any higher than that of M_1, anterointernal basal cusp (paraconid?) distinct, metaconid dependent on protoconid but likewise fully distinct, heel broad and well developed.

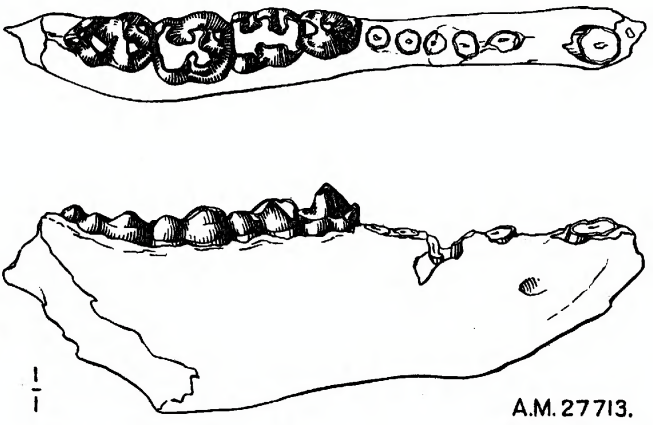

Fig. 4. *Protogonodon grangeri*, new species. Type, Amer. Mus. No. 27713, right lower jaw with crowns of P_4–M_3. Crown and external views. Natural size.

The specimen is sharply distinct from any of *P. pentacus* or most other specimens referred to species of *Protogonodon* in the character of P_4, in those forms much higher, with metaconid entirely absent or at most very faintly suggested and basal cusp and heel less developed. This tooth in *P. grangeri* has made a distinct advance toward molarization, a step which does not contradict the decidedly creodont-like character of the genus as a whole but which does tend to link it with *Tetraclaenodon*, as originally suggested by Scott.

The only form previously referred to *Protogonodon* which resembles *P. grangeri* in this respect is a lower jaw (Amer. Mus. No. 16928) doubtfully referred by Matthew to *Protogonodon protogonioides*. This has a P_4 of the same character as in *P. grangeri* although it is not the same species, being rather smaller and with distinctive molar proportions, especially M_2 which has the trigonid distinctly narrower than the talonid and also relatively shorter.

It seems not unlikely that *Protogonodon* includes two distinct groups, one, typified by *P. pentacus*, more creodont-like and not far from *Loxolophus*, the other, typified by *P. grangeri* and probably including *P. protogonioides*, more condylarth-like and possibly near the ancestry of *Tetraclaenodon*. As Matthew points out, the two lines of possible relationship are not mutually exclusive, even though *Loxolophus* and *Tetraclaenodon* are commonly referred to distinct orders.

The essential agreement of all the species of *Protogonodon* is so close that it is not possible to split the genus on present evidence, although this would perhaps be necessary if skull and, still better, foot material should add significantly to the condylarth-like characters of the group here distinguished.

Measurements:			
M_{1-3}			29.5 mm.
P_4	Length	7.5	
	Width	5.5	
M_1	Length	8.5	
	Width	7.5	
M_2	Length	10	
	Width	9	
M_3	Length	10.5	
	Width	7.5	

CONDYLARTHRA

Hyopsodontidae

Mioclaeninae

TIZNATZINIA,[1] NEW GENUS

TYPE.—*Tiznatzinia vanderhoofi*, new species.

DISTRIBUTION.—Both fossil levels of the Puerco Formation, New Mexico

DIAGNOSIS.—A small condylarth most nearly similar to *Oxyacodon* and *Ellipsodon*. P_4 little enlarged, slightly higher than M_1 and not wider, with distinct but single-cusped heel, and very small incipient metaconid. Molars low-crowned, cusps relatively low and blunt, trigonids little elevated above talonids. Paraconids more or less reduced, but always present, closely approximated and usually almost directly anterior to metaconids, partly confluent with the latter. Trigonids with shallow basins, nearly or quite closed. Deep talonid basins open through a narrow notch on the inner side, hypoconids large, entoconids and hypoconulids smaller and poorly differ-

[1] Tiz Natzin, locality name given by Sinclair and Granger near the type locality of this genus and species.

entiated, frequently with other minute cuspules on the talonid crescent. M_3 (referred species) reduced, hypoconulids not strongly projecting.

This genus is clearly allied rather closely to *Oxyacodon* and to *Ellipsodon* and is partly, but not altogether, intermediate between them. Its molar structure is very distinctive, having the blunter cusps, more turgid lower teeth, compressed trigonids, and reduced M_3 of *Ellipsodon*, but retaining the paraconids as in *Oxyacodon*. The paraconids are reduced, about to the same degree as in *Oxyacodon*, but in a different way, remaining more internal and higher on the crown, and tending to become confluent with the metaconids, the trigonid basin being closed or somewhat open on the anterior side at least on M_{1-2}, not the internal as in *Oxyacodon*. The genus, confined to the Puerco, seems to be nearly or directly ancestral to *Ellipsodon* of the Torrejon.

To this genus are also referred *Mioclaenus turgidunculus* Cope and *Ellipsodon priscus* Matthew. The former is referred by Matthew to *Oxyacodon* but as shown by his description, and still more clearly by the specimens and in the light of the new species described below, it was highly atypical in that genus. *Ellipsodon priscus*, also, was very atypical

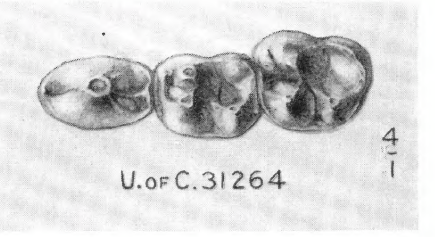

Fig. 5. *Tiznatzinia vanderhoofi*, new genus and species. Type, Univ. of California No. 31264, left P_4–M_2. Crown view. Four times natural size.

in the genus *Ellipsodon*, much more closely resembling its contemporary here described then it does the genotypic *E. inaequidens*. The three species seem clearly to form a natural and well-defined unit, contemporaneous with *Oxyacodon*, but evolving in a somewhat different direction, toward the later *Ellipsodon*.

Tiznatzinia vanderhoofi,[1] new species

TYPE.—Mus. Paleo. Calif. No. 31264. Part of left lower jaw with P_4–M_2. Collected by Camp and Vander Hoof, 1930.

HORIZON AND LOCALITY.—Upper fossil level, Puerco Formation, Barrel Spring Arroyo, San Juan Basin, New Mexico.

[1] V. L. Vander Hoof.

DIAGNOSIS.—Size small (see measurements). P_4 compressed. Trigonids of M_{1-2} subquadrate, paraconid wholly internal and larger and higher than in *T. priscus*. M_{1-2} longer than wide. Trigonid slightly narrower than talonid on M_1, wide on M_2. Mandible shallow.

Measurements:

P_4	Length	3.5
	Width	2.3
M_1	Length	3.2
	Width	2.9
M_2	Length	3.5
	Width	2.9

This species is slightly smaller than either *T. turgidunculus* or *T. priscus*. P_4 is more compressed and trenchant, the molar trigonids more quadrate, and the paraconids more strictly internal and more nearly confluent with the metaconids than in *T. turgidunculus*. The molars are relatively narrower and the paraconids relatively larger and somewhat higher on the crown than in *T. priscus*.

PLAGIOPTYCHUS MATTHEW *ex ms.*, NEW GENUS

TYPE.—*Periptychus coarctatus* Cope.

DISTRIBUTION.—Puerco Formation, San Juan Basin, New Mexico.

DIAGNOSIS.—Principal cusps of premolars pitched obliquely backward, the anterior basal cusps and deuteroconids of lower premolars wider than long, the basal portion of the crown extended inwardly, supplementary cusps not developed on molars. (Matthew.)

From more fragmentary material, Matthew placed the Puerco species hitherto referred to *Periptychus*, the type of which is from the Torrejon, in a new subgenus. The new 1929 material led him to raise the subgenus to generic rank. *Plagioptychus* is discussed at greater length in Matthew's San Juan Basin memoir, and is published here in brief in order to record its elevation to generic value, after Matthew's notes but not inserted by him in his manuscript, and in order to publish the following new species in its correct and definitive form without publishing an invalid generic name.

Plagioptychus matthewi, new species

TYPE.—Amer. Mus. No. 27712, right lower jaw with P_2–M_3. Found by G. G. Simpson.

HORIZON AND LOCALITY.—Upper level, Puerco Formation, Barrel Spring Arroyo, San Juan Basin, New Mexico.

DIAGNOSIS.—Over 10 per cent larger than average specimens of *P. coarctatus*. Lower premolars large and heavy. P_{3-4} with small but distinct anterointernal basal cusp and well-developed heels. M_{1-3} with well-defined median external basal cuspule and M_{1-2} with smaller median internal basal cuspule. M_3 elongate, with hypoconulid lobe partly differentiated. M_3 at least (M_{1-2} being too worn for determination) with incipient central seventh cusp.

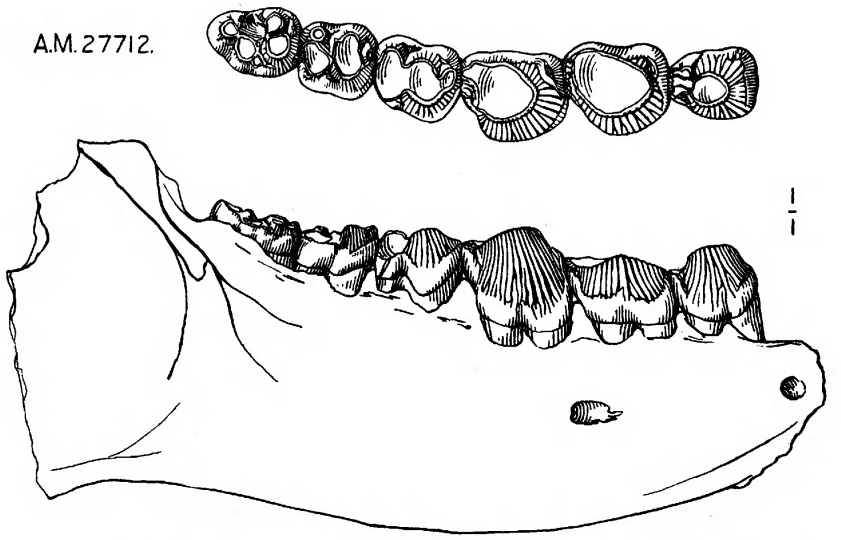

Fig. 6. *Plagioptychus matthewi*, new species. Type, Amer. Mus. No. 27712, right lower jaw with P_2–M_3. Crown and external views. Natural size.

Some of the more fragmentary previously known specimens may belong to this species, but it differs sharply from any other with which full comparison can be made, in spite of their considerable range of variation. It is interesting that all the distinctive characters are progressive. All are in the direction of the true Torrejon *Periptychus*, although the species is nevertheless very much closer to *Plagioptychus coarctatus* and does not really close the gap between the two genera to any very significant extent. The premolars are too worn to show the presence or absence of a rudimentary metaconid, although its presence would be in harmony with the other characters of the species.

Measurements:	P_2–M_3	69	mm.
	M_1–M_3	32	
	P_2	Length 11	
		Width 8.5	
	P_3	Length 12.5	
		Width 11	
	P_4	Length 13	
		Width 11.5	
	M_1	Length 10	
		Width 9	
	M_2	Length 10	
		Width 9	
	M_3	Length 11	
		Width 8.5	